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CLEMENTS' ORGANIC CHEMISTRY

A Manual of Organic Chemistry, Practical and Theoretical, for Colleges and Schools, Medical and Civil Service Examinations, and especially for Elementary, Advanced, and Honours Students at the Classes of the Science and Art Department, South Kensington. By Hugh Clements, of H.M. Civil Service. (Blackie and Son, 1879.)

A GOOD text-book should be correct as to facts and descriptions, so as to leave nothing for the student to unlearn; it should, without being tedious or cumbrous, be minute as to the information it contains, so as to spare the student the necessity of going over the same ground again; its arrangement should be thoroughly logical, building up the science from its first principles, and presenting it to the reader as a connected whole and not as a collection of dislocated and dissevered members; its language should be lucid, terse, and vigorous, in order to relieve the intellect and memory from any unnecessary strain; and, finally, it should be written by a person who not only knows the subject, but knows also how to teach it.

It is greatly to be feared that the encouragement offered by the Science and Art Department to the teaching of the various sciences included in its syllabus has not been productive of unalloyed good; it has called into existence a vast number of presuming and incompetent "science (so-called) teachers," and has undoubtedly been the ultimate cause of the deluge of illogical, incorrect, and imperfect text-books that has for years past flooded the educational market. These worthless and pernicious books naturally divide themselves into two classes, and it is very hard to tell which class is the more mischievous. In the first class we have the books that carry on their very faces conclusive evidence that they are written by individuals who know little or nothing of the subject they are pretending to treat—by men who have an enormous amount to learn before they can have anything whatever to teach. When these *savants* condescend to treat of experimental science, it becomes at once evident that they are writing about experiments they have never performed and apparatus they have never seen.

In the second class we have abler, but certainly not better books—these are the books written by fairly erudite authors, but written with a motive that is a disgrace to the author, an insult to the teacher, and a monstrous injustice to the student—they are the barefaced *cram books*—books written in order to enable the student to pass a specified examination, and not to aid him in obtaining any real knowledge of the subject. We are truly sorry to find that these miserable volumes are very extensively patronised and adopted by teachers, and if we are to judge from recent articles and speeches cramming and "spotting the questions" are considered not only legitimate but praiseworthy proceedings. For the credit of the teaching profession we are happy to say that there are many honest and able teachers with whom a correct and thorough knowledge of the subject is the first consideration, and a "pass" but a subordinate one; yet it must be confessed that an alarming number of teachers seem to think that "science teaching" consists in imparting to their students a few leading facts without any attempt at showing their connection or their bearing upon one another, and in getting them to learn, by *rote*, stereotyped answers to a few stock questions, trusting to chance that in one shape or another a sufficient number of these *stock questions* will turn up to enable their pupils to obtain at least 33 per cent. of attainable marks, and so entitle them to a "second class." Other teachers, considerably more able, but scarcely more conscientious, study the hobbies and the idiosyncracies of the examiners, and in the course of several years' practice manage to attain a wonderful amount of skill and success in securing passes. On the strength of this success they gain a pretty wide reputation as "excellent teachers," while in reality they impart to their pupils little or no knowledge of their subject as a science; all the information is conveyed and accepted on the mere *ipse dixit* of the teacher without any attempt at logical demonstration, and as a natural result teacher and taught get thoroughly imbued with a most pernicious dogmatism, which must be entirely eradicated before either becomes susceptible of any true scientific education. Much of the so-called science teaching has exactly the opposite effect to what the Science and Art Department intended it to have, and the money granted year by year has mostly gone to the pockets of successful crammers, while the honest painstaking teachers have had but a meagre share of the coveted loaves and fishes and a still more meagre share of fame.

Had Mr. Clements's volume been a solitary instance it would not have merited even a passing notice, but when we remember that it is only a specimen, and probably not the worst, of a rapidly-increasing class, we feel that as a representative of that class it deserves a fair and serious consideration. As some of the essentials of a good text-book, we have enumerated correctness and completeness as to facts and descriptions; when an author describes any process he should do it correctly and with sufficient minuteness to enable the student to comprehend every step of it, and, if he possesses the requisite apparatus, to go through it himself without further aid or direction. We shall quote from the book before us a few paragraphs relating to some of the simpler processes of organic chemistry, and let the reader judge how much assistance a student can derive from them. On pp. 3-13 the author gives directions how to perform "combustions" and the quantitative analysis of organic compounds generally. The engraving of the potash bulbs in Fig. 1, p. 4, is certainly misleading, and no one, either from the engraving or the accompanying explanation, could ever find out how the CO_2 finds its way to the bulbs *p*; if it was necessary to put in an engraving and a description of it at all, it was certainly quite as necessary that both should be correct and intelligible; at present they are neither. In his description of the method of determining the C and H in an organic compound, the author has hopelessly mixed up two distinct processes, viz., combustion in a closed tube and combustion in a current of air or oxygen. The tube in the engraving is represented as closed at one end, and there is no reference whatever to a tube open at both ends; consequently we fear that many students would attempt to introduce the platinum boat from the right-hand end of the tube. It may be said that their common

sense ought to show them otherwise; but when the author has had some years' practical experience, he will undoubtedly acknowledge that in scientific experiments very little reliance is to be placed on the common sense of beginners. The author says:—

"About one-fourth of the combustion tube is filled with copper oxide, the sugar weighed in a little glass tube, and shaken into the combustion tube and thoroughly mixed with the oxide by raking them together by a wire. The remainder of the tube is filled with oxide; or the sugar may be put in a platinum boat that will pass into the tube."

As an alternative, for *what* may the sugar be put in a platinum boat? It appears from the text that the boat is to be employed instead of filling up the "remainder of the tube with oxide." No further reference is made to the method of determining the C and H in organic compounds except on p. 11, where we are told that in the presence of nitrogenous substances the products of combustion must be passed over heated metallic copper, and we have failed to find a single hint to enable the student to determine the C and H in the presence of Cl, Br, I, S, or alkaline metals. All the processes given in the book, *supposing them to be intelligible to a beginner*, are utterly inadequate.

Referring to the determination of nitrogen, the author states (p. 12):—

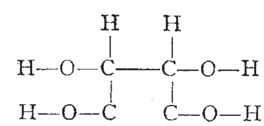
"The ammonia process answers, except in cases where the nitrogen occurs in the form of nitric acid or cyanogen, when this element must be estimated by volume. This method is applicable in all cases. A combustion tube of about 32 inches long is taken, rounded like a test tube at one end. This tube is filled with some carbonate that, when heated, will give off carbonic anhydride, such as manganous carbonate, magnesite or hydric sodic-carbonate, and some mercuric oxide. A weighed portion of the substance for analysis, with upwards of forty times its weight of a mixture of oxide of copper and mercury, the rinsings of the mortar, a plug of asbestos, then about 4 inches of cupric oxide, asbestos and a layer of about 8 inches of metallic copper. The end of the combustion tube is drawn out and connected with a bent delivery tube, dipping beneath the mercury in the trough. When all is ready the carbonate in the tube is heated to generate a current of carbonic anhydride to drive out all the air.

"The metallic copper and copper oxide are heated simultaneously, and when the escaping gas is free from air, insert the end of the delivery tube through the tubulure of the vessel," &c., &c.

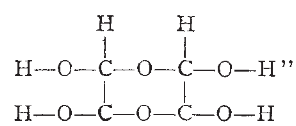
We suppose that Mr. Clements would barely maintain that the N occurs as *nitric* acid in nitromethane or any of its analogous compounds; but we should be very much surprised if he or any one else could make a correct determination of the nitrogen in those compounds by his ammonia method; and would it surprise him to learn that when N occurs as a component of cyanogen it may be correctly estimated by the ammonia method? What is the meaning of the remainder of the preceding extract? Having *filled* the tube with "some carbonate" and mercuric oxide, what is the student to do with the Benjamin's mess, the ingredients of which are enumerated in the next sentence, if a heap of words without a single predicate can be called a sentence? Without doubt the author meant a mixture of cupric and mercuric oxides by "a mixture of the oxide of copper and mercury," but a beginner, we should unhesitatingly say, would mix metallic mercury with oxide of copper if he had no other guide than this book. Then what mortar, trough, tubulure, and vessel are referred to? Where are they to come from, and what are they used for? A chemist may guess what is meant, but heaven help the beginner who tries to make his first nitrogen determination with the sole aid of this new light. We cannot believe it possible for a man who had ever "done a combustion" to have penned these pages 3-13.

We have neither space nor patience for further extracts from the author's description of processes and apparatus, but we would ask the reader to refer to pp. 164 and 165, where Messrs. Frankland and Ward's gas apparatus is described, and after he has read it let him try to find out how it was possible for a person who had ever seen the apparatus to write that description? or even if he had never seen it, how could he ignore the simplest principles of physics and propose to drive the gas from A by simply elevating M? The drawings and explanation are wofully incomplete and misleading.

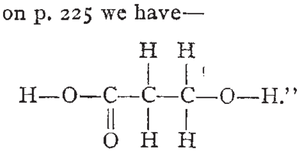
It is needless to point out all the errors of the author, but there is one class we cannot help referring to, as it gives us a fair test of the extent of the author's knowledge of his subject. To translate constitutional to graphic formulæ is considered a very elementary exercise, but in this our author fails miserably; thus he gives (p. 219):—

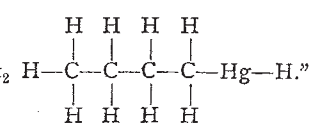
"Succinic Acid $\left\{\begin{array}{l}COHo\\CH_2\\CH_2\\COHo\end{array}\right.$ 

where the two lower atoms of C are represented as bivalent. On the same page he gives—

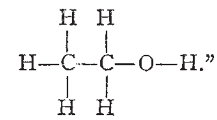
"Tartaric Acid $\left\{\begin{array}{l}COHo\\CHHo\\CHHo\\COHo\end{array}\right.$ 

where, as in the preceding, we have no oxatyl group in the graphic formula, although we have two such in each of the constitutional. Again, on p. 225 we have—

"Lactic Acid $\left\{\begin{array}{l}CMeHHo\\COHo\end{array}\right.$ 

"Mercuric Ethide, $HgEt_2$ 

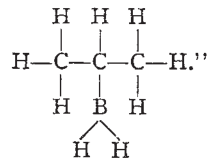
Where is the group Me in the first and the two groups of Et in the second? But to crown all he has begun this glorious page thus—

"Methylic Ether, $\left.\begin{array}{l}CH_3\\CH_3\end{array}\right\}O$ 

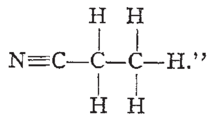
Is it possible that he does not know that this is the graphic formula of ethylic alcohol, EtHo, a very different compound indeed from Me_2O? We will not multiply instances, though we might very easily do so;

but we cannot resist the temptation to cull the two following gems :—

P. 228—
"Boric Methide, $B(CH_3)_3$

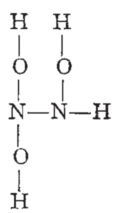


P. 234—
"Allylamine, $N(C_3H_5)H_2$



It is a great pity the author ever meddled with graphic formulæ—he may have some very original notions about the constitution of organic bodies, but for his own credit he ought to have made his constitutional and graphic formulæ agree. The only thing we ever saw at all approaching the preceding in ridiculous incongruity was the following, handed to us by a beginner :—

Ammonic Nitrate, $NO_2(NH_4O)$



We kept this as a curiosity, little dreaming that we should ever live to see it surpassed in a text-book.

In no instance can we say that the information is complete and satisfactory, while in very many cases it is decidedly misleading. We fear that very few of the *model* answers to the questions of the Science and Art Department would have been marked "*excellent*" or even "*good*" by the examiners. For instance—

"30. How can you detect the presence of nitrogen in an organic substance?
Ans. "See the estimation of nitrogen."

We have looked again and again through the pages referred to, and certainly there is nothing there about the detection of nitrogen; does the author know any difference between detection and estimation?

"35. If an alkaline solution of potassic cyanide be boiled what decomposition takes place?
"The formiate of potassium is formed and ammonia thus—$KCN + 2H_2O = KCOHo + NH_3$."

This answer is brief, if not to the point, but what on earth is *KCOHo?*

"74. How would you separate alcohol from acetic acid?
"Acetic acid freezes at 17° C. or under, while alcohol remains liquid at much lower temperatures."

Very simple, but has the author ever tried it?

"99. What chemical changes ensue when a mixture of ethylic iodide and zinc are heated to 150° C. in a sealed tube?
"$2EtI + Zn = ZnI + 2C_2H_5$."

Is that all? We fancied hitherto that the merest tyro in chemistry knew better. We have neither space nor inclination to give further specimens of these answers, but let the reader refer to Nos. 100, 101, 102, &c., and judge for himself if the answers are satisfactory.

If we look at the arrangement of the book we must admit that we can find no sequence or logical connection between one part and another. Terms are employed before being properly defined, and often without being defined at all. We most sincerely pity the students who may attempt to learn organic chemistry by following the order of this book without having many a missing link supplied. Under the head "Alcohols" we have three mentioned—Methylic, Ethylic, and Phenylic; and by referring back to the "Theory of Compound Organic Radicals," we find mention made of several others, but no scientific arrangement in series and no general methods for the synthesis or preparation otherwise of the various terms of each series. The same objection applies more or less to the treatment of the ethers, aldehydes, acids, and anhydrides. By the way, we have not often seen carbamide or urea called a diamine, nor ethylic butyrate, C_3H_7COEtO called "*butylic* ether;" that term is generally reserved for $\left.\begin{matrix}C_4H_9\\C_4H_9\end{matrix}\right\}O$.

There are several pages giving nothing but the names and formulæ of compounds without any attempt to give their properties, their connection with one another, or the methods of preparing them; a few are referred to in other parts of the book, but necessarily they come before us then as isolated units and not as closely allied members of a consecutive series.

As to the language we need say but little. It is generally awkward or ambiguous, and often incorrect. The way pronouns and conjunctions are employed is sometimes alarming; in one paragraph of very moderate length we have the little word *or* occurring at least nineteen times, until we begin to think that the author has been taking the Apostle Paul for his model. In other places the pronoun *it* keeps dancing before our face like some imp, peering out of the most unexpected nooks and corners. Here is a model sentence—"A subsidence of temperature and an almost total absence of precipitated iodine after a few drops of the liquid remaining in the flask is boiled with HNO_3." What *is* boiled? is it the subsidence of temperature?

We have by no means pointed out the worst errors—we have purposely confined our remarks to the most elementary, and we think the reader will now be able to answer for himself whether the present author "knows his subject and knows how to teach it," or not.

One extract more and we have done with the book and its author, who says on p. 61 :—"Nitrous oxide and carbonic anhydride are other anæsthetics." Well, so they are, and we could only wish some people had the toothache "awful" and had the latter anæsthetic administered to alleviate their pain, and *ours*.

As we have said before, we have reviewed this book as a sample—and not the worst—of an ever-increasing class of publications, and we would ask teachers is it any wonder that "science teaching" has in many instances become a byeword and a reproach? Can we expect any different result until all sham-books and cram-books are consigned to the oblivion they so richly deserve?

E. H.